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TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		ATTORNEY'S DOCKET NUMBER 10191/2250	
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INTERNATIONAL APPLICATION NO. PCT/DE01/02147	INTERNATIONAL FILING DATE (08.06 01) 08 June 2001	PRIORITY DATE(S) CLAIMED (14.06.00) 14 June 2000	
TITLE OF INVENTION TWO-PART SOLENOID AND METHOD FOR THE MANUFACTURE THEREOF			
APPLICANT(S) FOR DO/EO/US HANS, Waldemar; LINSSEN, Mathias; VOGEL, Christof and HENNEMANN, Helmut			
Applicant(s) herewith submit to the United States Designated/Elected Office (DO/EO/US) the following items and other information			
1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371. 2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371. 3. <input checked="" type="checkbox"/> This is an express request to begin national examination procedures (35 U.S.C. 371(f)) immediately rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1). 4. <input type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date. 5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2)) a. <input type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau). b. <input checked="" type="checkbox"/> has been transmitted by the International Bureau. c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US) 6. <input checked="" type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)) 7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)) a. <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau). b. <input type="checkbox"/> have been transmitted by the International Bureau c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired. d. <input checked="" type="checkbox"/> have not been made and will not be made. 8. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)). 9. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)) (unsigned). 10. <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).			
Items 11. to 16. below concern other document(s) or information included:			
11. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98. 12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included 13. <input checked="" type="checkbox"/> A FIRST preliminary amendment. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment. 14. <input checked="" type="checkbox"/> A substitute specification and a marked up version thereof. 15. <input type="checkbox"/> A change of power of attorney and/or address letter 16. <input checked="" type="checkbox"/> Other items or information: International Search Report (translated) and Form PCT/RO/101			

[10191/2250]

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants : Waldemar HANS et al.
Serial No. : To Be Assigned
Filed : Herewith
For : TWO-PART SOLENOID AND METHOD FOR THE
MANUFACTURE THEREOF
Examiner : To Be Assigned
Group Art Unit : To Be Assigned

Assistant Commissioner for Patents
Washington, D.C. 20231

PRELIMINARY AMENDMENT

SIR:

Please amend the above-identified application before examination as follows:

IN THE SPECIFICATION AND ABSTRACT:

In accordance with 37 C.F.R. § 1.121(b)(3), a Substitute Specification (including the Abstract but without claims) accompanies this response. It is respectfully requested that the Substitute Specification be entered to replace the Specification of record.

IN THE CLAIMS:

Please cancel Claims 1-17, without prejudice, and add new Claims 18-34 as follows:

- 18. (New) A connectable solenoid for use with a housing body, comprising:
- a solenoid having a substantially cylindrical hollow bobbin made of an insulating material adapted to be coupled to the housing body and provided with at least two relay connectors anchored in an end area of the bobbin and projecting axially therefrom; and
 - a contact element;
- wherein the solenoid and the contact element are two separate components

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which are connected to each other by a connecting part of the contact element attached to the housing body.

19. (New) The connectable solenoid according to claim 18, wherein the contact element has at least two extensions that are connected to the relay connectors of the solenoid.
20. (New) The connectable solenoid according to claim 19, wherein the contact element is attached to the relay connectors of the solenoid by one of soldering and welding.
21. (New) The connectable solenoid according to claim 20, wherein the contact element has at least two contact tabs which are connected to each other by a web.
22. (New) The connectable solenoid according to claim 21, wherein the contact tabs have holes.
23. (New) The connectable solenoid according to claim 22, wherein the contact element is connected to the connecting part by a first plastic web, the first plastic web extending between the contact tabs, and each of the holes located in the contact tabs being embedded in the first plastic web.
24. (New) The connectable solenoid according to claim 23, wherein two further holes are connected to each other by a second plastic web which extends between the contact tabs.
25. (New) The connectable solenoid according to claim 18, wherein the connecting part partially surrounds the housing body.
26. (New) The connectable solenoid according to claim 18, wherein the housing body is cylindrical in shape.

27. (New) The connectable solenoid according to claim 18, wherein the connecting part surrounds the housing body in an angular range that is greater than 180°.
28. (New) The connectable solenoid according to claims 18, wherein the connecting part is made of an elastic plastic.
29. (New) The connectable solenoid according to claim 23, wherein the connecting part is injection-molded onto the first plastic web.
30. (New) The connectable solenoid according to claim 29, wherein a portion of each of the at least two contact tabs is bent at an angle.
31. (New) A method for connecting a connectable solenoid to at least one contact element, the solenoid being made of an insulating material and having a substantially cylindrical, hollow bobbin which is slid onto a housing body and is provided with at least two relay connectors that are anchored in an end area of the bobbin and project axially from it, the method comprising the steps of:
 - mounting the solenoid onto the housing body;
 - mounting a connecting part attached to the contact element, on the housing body; and
 - connecting the contact element to the relay connectors.
32. (New) The method according to claim 31, further comprising the step of bending the relay connectors of the solenoid at a predetermined angle.
33. (New) The method according to claim 32, wherein the contact element has contact tabs, and the method further comprises bending the contact tabs toward the connecting part at a predetermined angle.
34. (New) The method according to claim 33, wherein a web extends between the contact tabs, the method further comprising the step of punching out the web

extending between the contact tabs of the contact element.--

REMARKS

This Preliminary Amendment cancels Claims 1-17 in the underlying PCT Application No. PCT/DE01/02147, and adds new Claims 18-34. The new claims do not add new matter to the application but do conform the claims to U.S. Patent and Trademark Office rules.

The amendments to the specification and abstract are to conform the specification and abstract to U.S. Patent and Trademark Office rules. The amendments to the specification and abstract do not introduce new matter into the application.

The underlying PCT application includes an International Search Report dated October 18, 2001, a copy of which is provided herewith.

Applicants assert that the present invention is new, non-obvious, and useful. Consideration and allowance of the claims are requested.

The Examiner is also invited to contact the undersigned attorney if any communication is believed to be helpful in advancing the examination of the present application.

Respectfully submitted,

Dated: February 14, 2002

By: 

Richard L. Mayer
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Summary of the Invention

The solenoid according to the present invention has the advantage over the related art that the short relay connectors enable the solenoid to be easily handled in subsequent processing steps, and, in addition, a contact element of any shape, for example a flat connector, may be attached to the solenoid by a simple snap-on connection and subsequently connected to the relay connectors.

An advantage of this invention is the easy manufacture of the relay connectors and contact elements, which may be manufactured, for example, by punching them out of a metal sheet.

The connecting part between the solenoid and the contact element is advantageously made of a flexible plastic which enables the contact element to be mounted on the bobbin or the valve housing.

The contact tabs of the contact element are still connected during manufacturing, which makes it easier to correctly position the contact tabs relative to each other. After being extrusion-coated with plastic, the contact tabs are separated by punching.

The angled extensions of the contact tabs give the contact element a shape that allows it to be easily connected to the relay connectors.

Brief Description of the Drawings

Figure 1A shows a schematic top view of a relay connector of a solenoid according to the present invention.

Figure 1B shows a schematic side view of a relay connector of a solenoid according to the present invention.

Figure 1C shows a sectional view of a cross-section taken along the line marked IC-IC in Figure 1A.

Figure 2A shows a schematic view of the bobbin of a solenoid according to the present invention.

Figure 2B shows a longitudinal section of the bobbin of a solenoid according to the present invention.

Figure 2C shows an enlarged view of area IIC shown in Figure 2B.

Figure 3A shows a cross-section of a solenoid according to the present invention.

Figure 3B shows a schematic side view of the solenoid shown in Figure 3A.

Figure 4A shows a schematic view of the contact element of the solenoid according to the present invention in first of three consecutive stages of processing.

Figure 4B shows a schematic view of the contact element of the solenoid according to the present invention in second of three consecutive stages of processing.

Figure 4C shows a schematic view of the contact element of the solenoid according to the present invention in third of three consecutive stages of processing.

Figure 5A shows a schematic representation of the first method step according to the present invention for connecting the solenoid to the contact element.

Figure 5B shows a schematic representation of the second method step according to the present invention for connecting the solenoid to the contact element.

5 Figure 5C shows a schematic representation of the third method step according to the present invention for connecting the solenoid to the contact element.

10 Figure 5D shows a schematic representation of the fourth method step according to the present invention for connecting the solenoid to the contact element.

15 Figure 5E shows a schematic representation of the fifth method step according to the present invention for connecting the solenoid to the contact element.

Detailed Description of the Invention

20 Solenoid 2 according to the present invention, shown in Figure 3B, is suitable, in particular, as a component for a fuel-injection valve like those used, for example, to inject fuel into the combustion chamber of a mixture-compressing, internal combustion engine with externally supplied ignition.

25 Figures 1A-1C show a schematic representation of a relay connector or terminal support 1 of a solenoid 2 according to the present invention in different views.

30 Figure 1A shows a top view of relay connector 1, which is needed to suitably hold in place wire ends 7 of wire 6, which is shown in Figure 3B, and which is wound to form solenoid 2, so that the ends may be connected to electrical lines leading to a control unit for the fuel injection valve.

35 Relay connector 1 has a generally tab-like shape having side or lateral projections 25 and 26. Shorter projections 25 are used,

in particular, to stabilize the position of relay connector 1 in a bobbin 3.

Projections 26 are used to widen the surface of relay connector 1 so that, after bobbin 3 has been wound, the ends of winding 5 can be attached to relay connector 1, for example by soldering.

Relay connector 1 also has holes 27 and 28, which, like projections 25 and 26, are used to fix relay connector 1 in place in bobbin 3 or to fasten wire ends 7. For example, wire ends 7 may be fed through hole 28 and then pinched. Hole 27 is filled with plastic when relay connector 1 is injected into bobbin 3, thereby securing relay connector 1 in place in bobbin 3.

Figure 1B shows a corresponding side view of relay connector 1. Due to its simple shape, relay connector 1 may be easily produced, for example, by punching it out of a metal sheet.

Figure 1C shows a cross-section along the line marked IC-IC in Figure 1A. In an exemplary embodiment, relay connector 1 may have rounded edges, which further simplifies processing.

Figures 2A-2B show a schematic view and a schematic longitudinal section, respectively, of bobbin 3 of a solenoid 2 according to the present invention, and Figure 2C shows an enlarged view of the area marked IIC in Figure 2B.

Figure 2A shows a schematic side view of unwound bobbin 3 having relay connectors 1 already attached to bobbin 3. Because of their simple shape, relay connectors 1 are easily connectable to bobbin 3. Bobbin 3 is principally made of plastic by injection molding. Relay connector 1 is injected into bobbin 3 up to lateral projections 25.

Bobbin 3 has a largely cylindrical hollow design with a circumferential recess 30 for holding winding 5.

5 An extension 4 of bobbin 3, which forms an end area and extends the cylindrical hollow cross-section of bobbin 3 in an angular range of approximately 40° , is molded onto bobbin 3. Relay connectors 1 are injected in one end area 31 of extension 4.

10 Figure 2B shows a longitudinal section of bobbin 3 of solenoid 2 according to the present invention, illustrated in a schematic sectional representation. Relay connectors 1 are attached in projecting end area 31 of extension 4 of bobbin 3.

15 Figure 2C shows an enlarged view of section IIC of Figure 2B for further clarification. Relay connectors 1 are inserted into extension 4 of bobbin 3 up to the point marked E in Figure 1A.

20 Figure 3A shows a view of the relay connector end of a solenoid 2 according to the present invention. Of a winding 5 of solenoid 2, only wire ends 7, which are wound around relay connector 1, are visible.

25 Figure 3B shows a side view of a solenoid 2 according to the present invention, around which winding 5 of a wire 6 is wound on bobbin 3. Wire ends 7 are routed from winding 5 of solenoid 2 via extension 4 of bobbin 3 to relay connectors 1. Wire ends 7 are routed to relay connectors 1 in an indentation 32 provided in extension 4 of bobbin 3, and they are wound around relay connectors 1 at least once in the area between projections 25 and 30 26 and may have flattened segments 8 for better attachment to relay connectors 1. Possible attachment methods include welding or soldering or even fixing wire ends 7 in hole 27.

Figures 4A-4C show schematic representations of three consecutive processing steps in the manufacture of a contact element 9 according to the present invention.

Figure 4A shows a schematic view of one exemplary embodiment of contact element 9, which, like relay connectors 1, is easily punchable from a metal sheet. Contact element 9 has two contact tabs 10 which have rounded front edges 11. Both contact tabs 10 are punched out in a single piece, connected by a web 12 which is removed later on. Two extensions 13 projecting outward at a desired angle are provided at the end of contact element 9 opposite rounded edges 11. Extensions 13 are used for connection to relay connectors 1 in a later processing step. Multiple holes 14a, 14b are provided in contact tabs 10 of contact element 9, with the present exemplary embodiment having two holes per contact tab 10.

In the next processing step, whereby contact element 9 is extrusion-coated, the plastic enters holes 14a, 14b, securely anchoring contact tabs 10 of contact element 9 in the plastic.

Figure 4B shows a schematic view of contact element 9 after contact tabs 10 have been extrusion-coated with plastic. A first plastic web 15 is formed in the area of holes 14a. The plastic enters holes 14a and holds contact tabs 10 a certain distance apart, determined by the width of web 12. A connecting part 16 according to the present invention is injection-molded onto plastic web 15. For stability, a second plastic web 19 is provided in the area of holes 14b and used to stabilize the position of contact tabs 10 relative to one another.

To electrically isolate contact tabs 10, metallic web 12 is removed by punching.

First plastic web 15 continues into connecting part 16, which was injection-molded onto contact element 9, using a suitable apparatus which is not illustrated in any further detail here. Connecting part 16 is in the shape of a hollow cylinder that is open at one end. Slightly more than half of the cylinder wall is designed as a complete hollow cylinder. Extensions 13, which will connect contact tabs 10 to relay connectors 1 later on, project laterally from plastic web 15.

Figure 4C shows a side view of the exemplary embodiment of contact element 9 illustrated in Figure 4B after a further processing step. In this processing step, contact element 9 is bent at an approximately 30-degree angle toward the horizontal at a bending point 17 in the vicinity of plastic web 15.

Figures 5A-5E show a schematic representation of the method steps for connecting solenoid 2 according to the present invention to contact element 9.

Figure 5A shows a view similar to that in Figure 3A of the relay connector end of bobbin 3. Relay connectors 1 and wire ends 7 are visible in end area 4 of bobbin 3.

Figure 5B shows the same representation of bobbin 3 after relay connectors 1 have been bent. Relay connectors 1 are preferably bent outward at a 90-degree angle from their previous position.

Figure 5C shows a side view of solenoid 2 that is already mounted on a housing body 18. Housing body 18 has an external housing 21, which encapsulates solenoid 2, and an inner housing part 22 that grips solenoid 2 and has an outer diameter equal to the inner diameter of connecting part 16. Due to the special shape of connecting part 16 according to the present invention, it may be mounted on inner housing part 22 in a stable snap-on connection. Connecting part 16 surrounds inner housing part 22

in an area which forms an angle greater than 180 degrees, preventing connecting part 16 from sliding off inner housing part 22 in the radial direction.

5 Figure 5D shows the same view as Figures 5A and 5B, illustrating bobbin 3, which is mounted on inner housing part 22, with connecting element 9 positioned over connecting part 16. Extensions 13 of contact tabs 10 of contact element 9 come to rest on bent relay connectors 1 of bobbin 3. First plastic web
10 15 of contact tabs 10 of contact element 9 has an external shape that prevents connecting part 16 from sliding on internal housing part 22.

In the final method step, as shown in Figure 5E, contact element
15 9 is connected to relay connectors 1 by a weld 20 or by soldering it onto extensions 13. The welding or soldering step arrests contact element 9 firmly in its final position so that it cannot move in either axial or radial direction. This also establishes a secure electrical contact between contact element 9 and relay
20 connectors 1.

The present invention is not limited to the illustrated exemplary embodiment, but is also suitable for a contact element 9 having a wide variety of other shapes. According to the method of the
25 present invention, coils having multiple windings insulated against one another may be provided with a contact element of any design.

Abstract of the Disclosure

A solenoid including a substantially cylindrical hollow bobbin made of an insulating material is provided, which is mountable on a housing body and is provided with at least two relay connectors anchored in an end area of the bobbin and projecting axially therefrom, and the solenoid is also coupled to a contact element. The solenoid and the contact element are two separate components which are connectable to each other by a connecting part of the contact element attachable to the housing body, by a suitable securing method, e.g., by soldering or welding.

[10191/2250]

TWO-PART SOLENOID AND METHOD FOR THE MANUFACTURE THEREOF

[Background Information]

5 Field of the Invention

The present invention [is based on] relates to a two-part solenoid [according to the definition of the species in Claim 1,] and a method for the manufacture thereof [according to the definition of the species in Claim 14].

10

Background of the Invention

A solenoid [as recited in the preamble of Claim 1 is already known from] described in German Patent 295 14 315 U1[. The solenoid] includes a largely cylindrical hollow bobbin made of an insulating material that is provided with two relay connectors anchored in an end area of the bobbin and projecting axially therefrom, with which it [being] is possible to wind the bobbin mechanically. The bottom of the bobbin forming the bottom of the winding space has variable adjacent winding levels in the axial direction which are offset against one another in the radial direction, with the transitions between the winding levels being designed as a bevel having an inclination of approximately 30 degrees. Except in the transition areas, the bottom of the bobbin is provided with grooves for the winding wire.

25

The disadvantage of the solenoid [known from] described in the above-mentioned German Patent 295 14 315 U1 lies, in particular, in the overall length of the solenoid, which is determined by the length of the relay connector. This makes the solenoid susceptible to damage, for example, when mechanically winding the coil wire. The relay connectors have a tendency to bend.

30

Another disadvantage is that different flat connectors for the electrical lines may require different manufacturing methods, which complicates the production process and makes it expensive.

5 Summary of the Invention

10 The solenoid according to the present invention [having the features of Claim 1, and the method according to the present invention for the manufacture of a solenoid, having the features of Claim 14, have] has the advantage over the related art that the short relay connectors enable the solenoid to be easily handled in subsequent processing steps, and, in addition, a contact element of any shape, for example a flat connector, may be attached to the solenoid by a simple snap-on connection and
15 subsequently [soldered] connected to the relay connectors.

20 [The features described in the subordinate claims represent advantageous embodiments of the solenoid indicated in Claim 1 and the method indicated in Claim 14.]

25 [One particular] An advantage of this invention is the easy manufacture of the relay connectors and contact elements, which may be manufactured, for example, by punching them out of a metal sheet.

30 The connecting part between the solenoid and the contact element is advantageously made of a flexible plastic which enables the contact element to be mounted on the bobbin or the valve housing.

35 The contact tabs of the contact element are still connected during manufacturing, which makes it easier to correctly position the contact tabs relative to each other. After being extrusion-coated with plastic, the contact tabs are separated by punching.

The angled extensions of the contact tabs give the contact element a shape that allows it to be easily connected to the relay connectors.

5 [Drawing] **Brief Description of the Drawings**

[An exemplary embodiment of the present invention is illustrated in simplified form in the drawing and explained in greater detail in the description below, where:]

10

Figure 1A shows a schematic top view of a relay connector of a solenoid according to the present invention[,].

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Figure 1B shows a schematic side view of a relay connector of a solenoid according to the present invention[,].

20

Figure 1C shows a sectional view of a cross-section taken [schematic section] along the line [of intersection] marked IC-IC in Figure 1A[,].

25

Figure 2A shows a schematic view of the bobbin of a solenoid according to the present invention[,].

Figure 2B shows a [schematic] longitudinal section of the bobbin of a solenoid according to the present invention[,].

Figure 2C shows [a detail] an enlarged view of area IIC [from] shown in Figure 2B[,].

30

Figure 3A shows a [schematic] cross-section of a solenoid according to the present invention[,].

Figure 3B shows a schematic side view [according to] of the solenoid shown in Figure 3A[,].

Figure[s] 4A[-C] shows a schematic view of the contact element of the solenoid according to the present invention in first of three consecutive stages of processing[; and].

5 Figure 4B shows a schematic view of the contact element of the solenoid according to the present invention in second of three consecutive stages of processing.

10 Figure 4C shows a schematic view of the contact element of the solenoid according to the present invention in third of three consecutive stages of processing.

15 Figure[s] 5A[-E] shows a schematic representation of the first method step[s] according to the present invention for connecting the solenoid to the contact element.

20 Figure 5B shows a schematic representation of the second method step according to the present invention for connecting the solenoid to the contact element.

Figure 5C shows a schematic representation of the third method step according to the present invention for connecting the solenoid to the contact element.

25 Figure 5D shows a schematic representation of the fourth method step according to the present invention for connecting the solenoid to the contact element.

30 Figure 5E shows a schematic representation of the fifth method step according to the present invention for connecting the solenoid to the contact element.

[Description of the Exemplary Embodiment]

Detailed Description of the Invention

Solenoid 2 according to the present invention, shown in Figure 3B, is suitable, in particular, as a component for a fuel-injection valve like those used, for example, to inject fuel into the combustion chamber of a mixture-compressing, internal combustion engine with externally supplied ignition.

Figures 1A-1C show a schematic representation of a relay connector or terminal support 1 of a solenoid 2 according to the present invention in different views.

Figure 1A shows a top view of relay connector 1, which is needed to suitably hold in place wire ends 7 of wire 6, which is shown in Figure 3B, and which is wound to form solenoid 2, so that the ends may be connected to electrical lines leading to a control unit for the fuel injection valve.

Relay connector 1 has a generally tab-like shape having side or lateral projections 25 and 26. Shorter projections 25 are used, in particular, to stabilize the position of relay connector 1 in a bobbin 3.

Projections 26 are used to widen the surface of relay connector 1 so that, after bobbin 3 has been wound, the ends of winding 5 can be attached to relay connector 1, for example by soldering.

Relay connector 1 also has holes 27 and 28, which, like projections 25 and 26, are used to fix relay connector 1 in place in bobbin 3 or to fasten wire ends 7. For example, wire ends 7 may be fed through hole 28 and then pinched. Hole 27 is filled with plastic when relay connector 1 is injected into bobbin 3, thereby securing relay connector 1 in place in bobbin 3.

Figure 1B shows a corresponding side view of relay connector 1. Due to its simple shape, relay connector 1 may be easily produced, for example, by punching it out of a metal sheet.

Figure 1C shows a cross-section along the line marked IC-IC in Figure 1A. [As in the present] In an exemplary embodiment, relay connector 1 may have rounded edges, which further simplifies processing.

Figures 2A-2[C]B show a schematic view and a schematic longitudinal section, respectively, of bobbin 3 of a solenoid 2 [1] according to the present invention, [as well as a detail] and Figure 2C shows an enlarged view of the area marked IIC in Figure 2B.

Figure 2A shows a schematic side view of unwound bobbin 3 having relay connectors 1 already attached to bobbin 3. Because of their simple shape, relay connectors 1 are easily connectable to bobbin 3. Bobbin 3 is principally made of plastic by injection molding. Relay connector 1 is injected into bobbin 3 up to lateral projections 25.

Bobbin 3 has a largely cylindrical hollow design with a circumferential recess 30 for holding winding 5.

An extension 4 of bobbin 3, which forms an end area and extends the cylindrical hollow cross-section of bobbin 3 in an angular range of approximately 40°, is molded onto bobbin 3. Relay connectors 1 are injected in one end area 31 of extension 4.

Figure 2B shows a longitudinal section of bobbin 3 of solenoid 2 according to the present invention, illustrated in a schematic sectional representation. Relay connectors 1 are attached in projecting end area 31 of extension 4 of bobbin 3.

Figure 2C shows an enlarged view of section IIC of Figure 2B [in area IIC] for further clarification. Relay connectors 1 are inserted into extension 4 of bobbin 3 up to the point marked E in Figure 1A.

Figure 3A shows a view of the relay connector end of a solenoid 2 according to the present invention. Of a winding 5 of solenoid 2, only wire ends 7, which are wound around relay connector 1, are visible.

Figure 3B shows a side view of a solenoid 2 according to the present invention, around which winding 5 of a wire 6 is wound on bobbin 3. Wire ends 7 are routed from winding 5 of solenoid 2 via extension 4 of bobbin 3 to relay connectors 1. Wire ends 7 are routed to relay connectors 1 in an indentation 32 provided in extension 4 of bobbin 3, and they are wound around relay connectors 1 at least once in the area between projections 25 and 26 and may have flattened segments 8 for better attachment to relay connectors 1. Possible attachment methods include welding or soldering or even fixing wire ends 7 in hole 27.

Figures 4A-4C show schematic representations of three consecutive processing steps in the manufacture of a contact element 9 according to the present invention.

Figure 4A shows a schematic view of one exemplary embodiment of contact element 9, which, like relay connectors 1, is easily punchable from a metal sheet. Contact element 9 has two contact tabs 10 which have rounded front edges 11. Both contact tabs 10 are punched out in a single piece, connected by a web 12 which is removed later on. Two extensions 13 projecting outward at [any] a desired angle are provided at the end of contact element 9 opposite rounded edges 11. Extensions 13 are used for connection to relay connectors 1 in a later processing step. Multiple holes

14a, 14b are provided in contact tabs 10 of contact element 9, with the present exemplary embodiment having two holes per contact tab 10.

5 In the next processing step, whereby contact element 9 is extrusion-coated, the plastic enters holes 14a, 14b, securely anchoring contact tabs 10 of contact element 9 in the plastic.

10 Figure 4B shows a schematic view of contact element 9 after contact tabs 10 have been extrusion-coated with plastic. A first plastic web 15 is formed in the area of holes 14a. The plastic enters holes 14a and holds contact tabs 10 a certain distance apart, determined by the width of web 12. A connecting part 16 according to the present invention is injection-molded onto
15 plastic web 15. For stability, a second plastic web 19 is provided in the area of holes 14b and used to stabilize the position of contact tabs 10 relative to one another.

20 To electrically isolate contact tabs 10, metallic web 12 is removed by punching.

First plastic web 15 continues into connecting part 16, which was injection-molded onto contact element 9, using a suitable apparatus which is not illustrated in any further detail here.
25 Connecting part 16 is in the shape of a hollow cylinder that is open at one end. Slightly more than half of the cylinder wall is designed as a complete hollow cylinder. Extensions 13, which will connect contact tabs 10 to relay connectors 1 later on, project laterally from plastic web 15.

30 Figure 4C shows a side view of the exemplary embodiment of contact element 9 illustrated in Figure 4B after a further processing step. In this processing step, contact element 9 is

Figures 5A-5E show a schematic representation of the method steps for connecting solenoid 2 according to the present invention to contact element 9.

Figure 5A shows a view similar to that in Figure 3A of the relay connector end of bobbin 3. Relay connectors 1 and wire ends 7 are visible in end area 4 of bobbin 3.

Figure 5B shows the same representation of bobbin 3 after relay connectors 1 have been bent. Relay connectors 1 are preferably bent outward at a 90-degree angle from their previous position.

Figure 5C shows a side view of solenoid 2 that is already mounted on a housing body 18. Housing body 18 has an external housing 21, which encapsulates solenoid 2, and an inner housing part 22 that grips solenoid 2 and has an outer diameter equal to the inner diameter of connecting part 16. Due to the special shape of connecting part 16 according to the present invention, it may be mounted on inner housing part 22 in a stable snap-on connection. Connecting part 16 surrounds inner housing part 22 in an area which forms an angle greater than 180 degrees, preventing connecting part 16 from sliding off inner housing part 22 in the radial direction.

Figure 5D shows the same view as Figures 5A and 5B, illustrating bobbin 3, which is mounted on inner housing part 22, with connecting element 9 positioned over connecting part 16. Extensions 13 of contact tabs 10 of contact element 9 come to rest on bent relay connectors 1 of bobbin 3. First plastic web 15 of contact tabs 10 of contact element 9 has an external shape

that prevents connecting part 16 from sliding on internal housing part 22.

5 In the final method step, as shown in Figure 5E, contact element 9 is connected to relay connectors 1 by a weld 20 or by soldering it onto extensions 13. The welding or soldering step arrests contact element 9 firmly in its final position so that it cannot move in either [an] axial or radial direction. This also establishes a secure electrical contact between contact element 9
10 and relay connectors 1.

The present invention is not limited to the illustrated exemplary embodiment, but is also suitable for a contact element 9 having a wide variety of other shapes. According to the method of the
15 present invention, coils having multiple windings insulated against one another may be provided with a contact element of any design.

[Abstract

A solenoid (2) including a largely cylindrical hollow bobbin (3) made of an insulating material which is mountable on a housing body (18) and is provided with at least two relay connectors (1) anchored in an end area (4) of the bobbin (3) and projecting axially therefrom, with the solenoid also including a contact element (9). The solenoid (2) and the contact element (9) are two separate components which are connectable to each other by a connecting part (16) of the contact element (9) attachable to the housing body (18) and by bonding (20).

{Fig. 5E}]

Abstract of the Disclosure

A solenoid including a substantially cylindrical hollow bobbin made of an insulating material is provided, which is mountable on a housing body and is provided with at least two relay connectors anchored in an end area of the bobbin and projecting axially therefrom, and the solenoid is also coupled to a contact element. The solenoid and the contact element are two separate components which are connectable to each other by a connecting part of the contact element attachable to the housing body, by a suitable securing method, e.g., by soldering or welding.

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[10191/2250]

TWO-PART SOLENOID AND METHOD FOR THE MANUFACTURE THEREOF

Background Information

5 The present invention is based on a two-part solenoid according to the definition of the species in Claim 1, and a method for the manufacture thereof according to the definition of the species in Claim 14.

10 A solenoid as recited in the preamble of Claim 1 is already known from German Patent 295 14 315 U1. The solenoid includes a largely cylindrical hollow bobbin made of an insulating material that is provided with two relay connectors anchored in an end area of the bobbin and projecting axially therefrom,
15 with it being possible to wind the bobbin mechanically. The bottom of the bobbin forming the bottom of the winding space has variable adjacent winding levels in the axial direction which are offset against one another in the radial direction, with the transitions between the winding levels being designed
20 as a bevel having an inclination of approximately 30 degrees. Except in the transition areas, the bottom of the bobbin is provided with grooves for the winding wire.

The disadvantage of the solenoid known from German Patent
25 295 14 315 U1 lies, in particular, in the overall length of the solenoid, which is determined by the length of the relay connector. This makes the solenoid susceptible to damage, for example, when mechanically winding the coil wire. The relay connectors have a tendency to bend.

30 Another disadvantage is that different flat connectors for the electrical lines may require different manufacturing methods, which complicates the production process and makes it expensive.

Summary of the Invention

The solenoid according to the present invention having the features of Claim 1, and the method according to the present invention for the manufacture of a solenoid, having the features of Claim 14, have the advantage over the related art that the short relay connectors enable the solenoid to be easily handled in subsequent processing steps, and, in addition, a contact element of any shape, for example a flat connector, may be attached to the solenoid by a simple snap-on connection and subsequently soldered to the relay connectors.

The features described in the subordinate claims represent advantageous embodiments of the solenoid indicated in Claim 1 and the method indicated in Claim 14.

One particular advantage is the easy manufacture of the relay connectors and contact elements, which may be manufactured, for example, by punching them out of a metal sheet.

The connecting part between the solenoid and the contact element is advantageously made of a flexible plastic which enables the contact element to be mounted on the bobbin or the valve housing.

The contact tabs of the contact element are still connected during manufacturing, which makes it easier to correctly position the contact tabs relative to each other. After being extrusion-coated with plastic, the contact tabs are separated by punching.

The angled extensions of the contact tabs give the contact element a shape that allows it to be easily connected to the relay connectors.

Drawing

An exemplary embodiment of the present invention is illustrated in simplified form in the drawing and explained in greater detail in the description below, where:

- 5 Figure 1A shows a schematic top view of a relay connector of a solenoid according to the present invention,
- Figure 1B shows a schematic side view of a relay connector of a solenoid according to the present invention,
- 10 Figure 1C shows a schematic section along the line of intersection marked IC-IC in Figure 1A,
- Figure 2A shows a schematic view of the bobbin of a solenoid according to the present invention,
- 15 Figure 2B shows a schematic longitudinal section of the bobbin of a solenoid according to the present invention,
- Figure 2C shows a detail of area IIC from Figure 2B,
- Figure 3A shows a schematic cross-section of a solenoid according to the present invention,
- 20 Figure 3B shows a schematic side view according to Figure 3A,
- Figures 4A-C show a schematic view of the contact element of the solenoid according to the present invention in three consecutive stages of processing, and
- 25 Figures 5A-E show a schematic representation of the method steps according to the present invention for connecting the solenoid to the contact element.

30 Description of the Exemplary Embodiment

Solenoid 2 according to the present invention is suitable, in particular, as a component for a fuel-injection valve like

those used, for example, to inject fuel into the combustion chamber of a mixture-compressing, internal combustion engine with externally supplied ignition.

- 5 Figures 1A-1C show a schematic representation of a relay connector 1 of a solenoid 2 according to the present invention in different views.

10 Figure 1A shows a top view of relay connector 1, which is needed to suitably hold in place wire ends 7 of wire 6 which is wound to form solenoid 2, so that the ends may be connected to electrical lines leading to a control unit for the fuel injection valve.

15 Relay connector 1 has a generally tab-like shape having side projections 25 and 26. Shorter projections 25 are used, in particular, to stabilize the position of relay connector 1 in a bobbin 3.

20 Projections 26 are used to widen the surface of relay connector 1 so that, after bobbin 3 has been wound, the ends of winding 5 can be attached to relay connector 1, for example by soldering.

25 Relay connector 1 also has holes 27 and 28, which, like projections 25 and 26, are used to fix relay connector 1 in place in bobbin 3 or to fasten wire ends 7. For example, wire ends 7 may be fed through hole 28 and then pinched. Hole 27 is filled with plastic when relay connector 1 is injected into
30 bobbin 3, thereby securing relay connector 1 in place in bobbin 3.

35 Figure 1B shows a corresponding side view of relay connector 1. Due to its simple shape, relay connector 1 may be easily produced, for example, by punching it out of a metal sheet.

Figure 1C shows a cross-section along the line marked IC-IC in Figure 1A. As in the present exemplary embodiment, relay connector 1 may have rounded edges, which further simplifies processing.

Figures 2A-2C show a schematic view and a schematic longitudinal section of bobbin 3 of a solenoid 1 according to the present invention as well as a detail of the area marked IIC in Figure 2B.

Figure 2A shows a schematic side view of unwound bobbin 3 having relay connectors 1 already attached to bobbin 3. Because of their simple shape, relay connectors 1 are easily connectable to bobbin 3. Bobbin 3 is principally made of plastic by injection molding. Relay connector 1 is injected into bobbin 3 up to lateral projections 25.

Bobbin 3 has a largely cylindrical hollow design with a circumferential recess 30 for holding winding 5.

An extension 4 of bobbin 3, which forms an end area and extends the cylindrical hollow cross-section of bobbin 3 in an angular range of approximately 40° , is molded onto bobbin 3. Relay connectors 1 are injected in one end area 31 of extension 4.

Figure 2B shows a longitudinal section of bobbin 3 of solenoid 2 according to the present invention, illustrated in a schematic sectional representation. Relay connectors 1 are attached in projecting end area 31 of extension 4 of bobbin 3.

Figure 2C shows an enlarged section of Figure 2B in area IIC for further clarification. Relay connectors 1 are inserted into extension 4 of bobbin 3 up to the point marked E in Figure 1A.

Figure 3A shows a view of the relay connector end of a solenoid 2 according to the present invention. Of a winding 5 of solenoid 2, only wire ends 7, which are wound around relay connector 1, are visible.

5

Figure 3B shows a side view of a solenoid 2 according to the present invention, around which winding 5 of a wire 6 is wound on bobbin 3. Wire ends 7 are routed from winding 5 of solenoid 2 via extension 4 of bobbin 3 to relay connectors 1. Wire ends 10 7 are routed to relay connectors 1 in an indentation 32 provided in extension 4 of bobbin 3, and they are wound around relay connectors 1 at least once in the area between projections 25 and 26 and may have flattened segments 8 for better attachment to relay connectors 1. Possible attachment 15 methods include welding or soldering or even fixing wire ends 7 in hole 27.

15

Figures 4A-4C show schematic representations of three consecutive processing steps in the manufacture of a contact 20 element 9 according to the present invention.

Figure 4A shows a schematic view of one exemplary embodiment of contact element 9, which, like relay connectors 1, is easily punchable from a metal sheet. Contact element 9 has two 25 contact tabs 10 which have rounded front edges 11. Both contact tabs 10 are punched out in a single piece, connected by a web 12 which is removed later on. Two extensions 13 projecting outward at any angle are provided at the end of contact element 9 opposite rounded edges 11. Extensions 13 are 30 used for connection to relay connectors 1 in a later processing step. Multiple holes 14a, 14b are provided in contact tabs 10 of contact element 9, with the present exemplary embodiment having two holes per contact tab 10.

30

In the next processing step, whereby contact element 9 is 35 extrusion-coated, the plastic enters holes 14a, 14b, securely anchoring contact tabs 10 of contact element 9 in the plastic.

35

Figure 4B shows a schematic view of contact element 9 after contact tabs 10 have been extrusion-coated with plastic. A first plastic web 15 is formed in the area of holes 14a. The plastic enters holes 14a and holds contact tabs 10 a certain distance apart, determined by the width of web 12. A connecting part 16 according to the present invention is injection-molded onto plastic web 15. For stability, a second plastic web 19 is provided in the area of holes 14b and used to stabilize the position of contact tabs 10 relative to one another.

To electrically isolate contact tabs 10, metallic web 12 is removed by punching.

First plastic web 15 continues into connecting part 16, which was injection-molded onto contact element 9, using a suitable apparatus which is not illustrated in any further detail here. Connecting part 16 is in the shape of a hollow cylinder that is open at one end. Slightly more than half of the cylinder wall is designed as a complete hollow cylinder. Extensions 13, which will connect contact tabs 10 to relay connectors 1 later on, project laterally from plastic web 15.

Figure 4C shows a side view of the exemplary embodiment of contact element 9 illustrated in Figure 4B after a further processing step. In this processing step, contact element 9 is bent at an approximately 30-degree angle toward the horizontal at a bending point 17 in the vicinity of plastic web 15.

Figures 5A-5E show a schematic representation of the method steps for connecting solenoid 2 according to the present invention to contact element 9.

Figure 5A shows a view similar to that in Figure 3A of the relay connector end of bobbin 3. Relay connectors 1 and wire ends 7 are visible in end area 4 of bobbin 3.

Figure 5B shows the same representation of bobbin 3 after relay connectors 1 have been bent. Relay connectors 1 are preferably bent outward at a 90-degree angle from their previous position.

5

Figure 5C shows a side view of solenoid 2 that is already mounted on a housing body 18. Housing body 18 has an external housing 21, which encapsulates solenoid 2, and an inner housing part 22 that grips solenoid 2 and has an outer diameter equal to the inner diameter of connecting part 16. Due to the special shape of connecting part 16 according to the present invention, it may be mounted on inner housing part 22 in a stable snap-on connection. Connecting part 16 surrounds inner housing part 22 in an area which forms an angle greater than 180 degrees, preventing connecting part 16 from sliding off inner housing part 22 in the radial direction.

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Figure 5D shows the same view as Figures 5A and 5B, illustrating bobbin 3, which is mounted on inner housing part 22, with connecting element 9 positioned over connecting part 16. Extensions 13 of contact tabs 10 of contact element 9 come to rest on bent relay connectors 1 of bobbin 3. First plastic web 15 of contact tabs 10 of contact element 9 has an external shape that prevents connecting part 16 from sliding on internal housing part 22.

30

In the final method step, as shown in Figure 5E, contact element 9 is connected to relay connectors 1 by a weld 20 or by soldering it onto extensions 13. The welding or soldering step arrests contact element 9 firmly in its final position so that it cannot move in either an axial or radial direction. This also establishes a secure electrical contact between contact element 9 and relay connectors 1.

35

The present invention is not limited to the illustrated exemplary embodiment, but is also suitable for a contact

element 9 having a wide variety of other shapes. According to the method, coils having multiple windings insulated against one another may be provided with a contact element of any design.

What is claimed is:

1. A solenoid (2) having a largely cylindrical hollow bobbin (3) which is made of an insulating material, may be slid onto a housing body (18) and is provided with at least two relay connectors (1) anchored in an end area (4) of the bobbin (3) and projecting axially therefrom; and having a contact element (9),

wherein the solenoid (2) and the contact element (9) are two separate components, which are connectable to each other by a connecting part (16) of the contact element (9) attachable to the housing body (18), and by bonding (20).

2. The solenoid according to Claim 1, wherein the contact element (9) has at least two extensions (13) that are connectable by the bond (20) to the relay connectors (1) of the solenoid (2).

3. The solenoid according to Claim 1 or 2, wherein the bond (20) is preferably formed by welding or soldering.

4. The solenoid according to one Claims 1 through 3, wherein the contact element (9) has at least two contact tabs (10) which are connected to each other by a web (12).

5. The solenoid according to Claim 4, wherein the contact tabs (10) have holes (14a, 14b).

6. The solenoid according to Claim 4 or 5, wherein the contact element (9) is connected to the connecting part (16) by a first plastic web (15), the first plastic web (15) extending between the contact tabs (10), and each of the holes (14a) located in the contact tabs (10) being embedded in the first plastic web (15).

7. The solenoid according to Claim 6,

wherein two further holes (14b) are connected to each other by a second plastic web (19) which extends between the contact tabs (10).

8. The solenoid according to one of Claims 1 through 7, wherein the connecting part (16) partially surrounds the housing body (18).

9. The solenoid according to Claim 8, wherein the housing body (18) is cylindrical in shape.

10. The solenoid according to Claim 9, wherein the connecting part (16) surrounds the housing body (18) in an angular range that is greater than 180° .

11. The solenoid according to one of Claims 1 through 10, wherein the connecting part (16) is preferably made of an elastic plastic.

12. The solenoid according to Claim 6 or 7, wherein the connecting part (16) is injection-molded onto the first plastic web (15).

13. The solenoid according to Claim 12, wherein extensions (13) of the at least two contact tabs (10) are bent at an angle.

14. A method for connecting a solenoid (2) to at least one contact element (9), the solenoid being made of an insulating material, and having a largely cylindrical, hollow bobbin (3), which may be slid onto a housing body (18) and is provided with at least two relay connectors (1) that are anchored in an end area (4) of the bobbin (3) and project axially from it; the method having the following method steps:

- mounting of the solenoid (2) on the housing body (18);
- mounting of a connecting part (16) attached to the contact element (9), on the housing body (18); and

- connection of the contact element (9) to the relay connectors (1) by bonding (20).

15. The method according to Claim 14, wherein the relay connectors (1) of the solenoid (2) are bent at a predetermined angle.

16. The method according to Claim 15, wherein the contact tabs (10) of the contact element (9) are bent toward the connecting part (16) at a predetermined angle.

17. The method according to Claim 16, wherein a web (12) extending between the contact tabs (10) of the contact element (9) is punched out.

Abstract

A solenoid (2) including a largely cylindrical hollow bobbin (3) made of an insulating material which is mountable on a housing body (18) and is provided with at least two relay connectors (1) anchored in an end area (4) of the bobbin (3) and projecting axially therefrom, with the solenoid also including a contact element (9). The solenoid (2) and the contact element (9) are two separate components which are connectable to each other by a connecting part (16) of the contact element (9) attachable to the housing body (18) and by bonding (20).

{Fig. 5E}

1/3

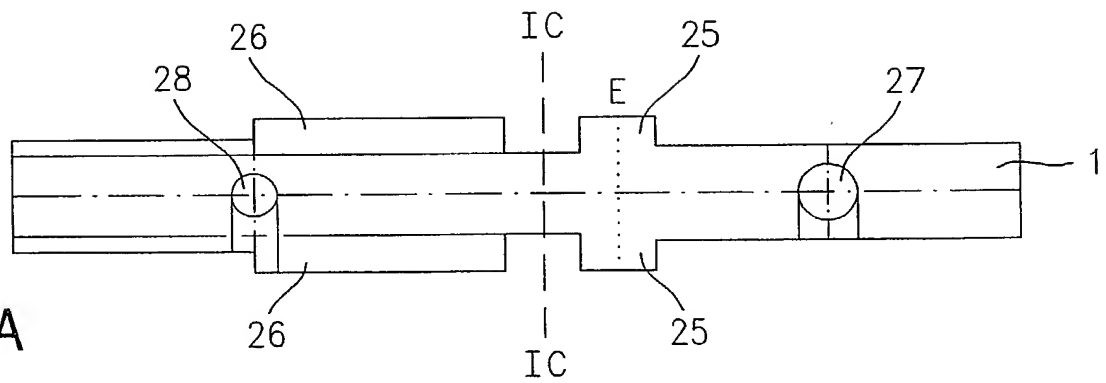


Fig. 1A

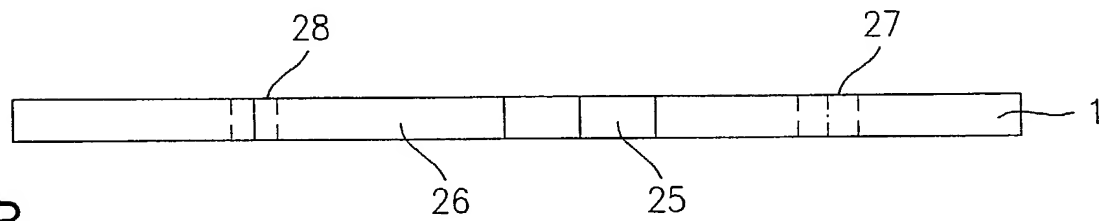


Fig. 1B

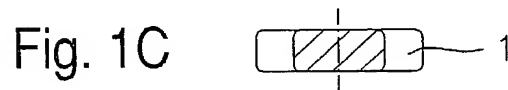


Fig. 1C

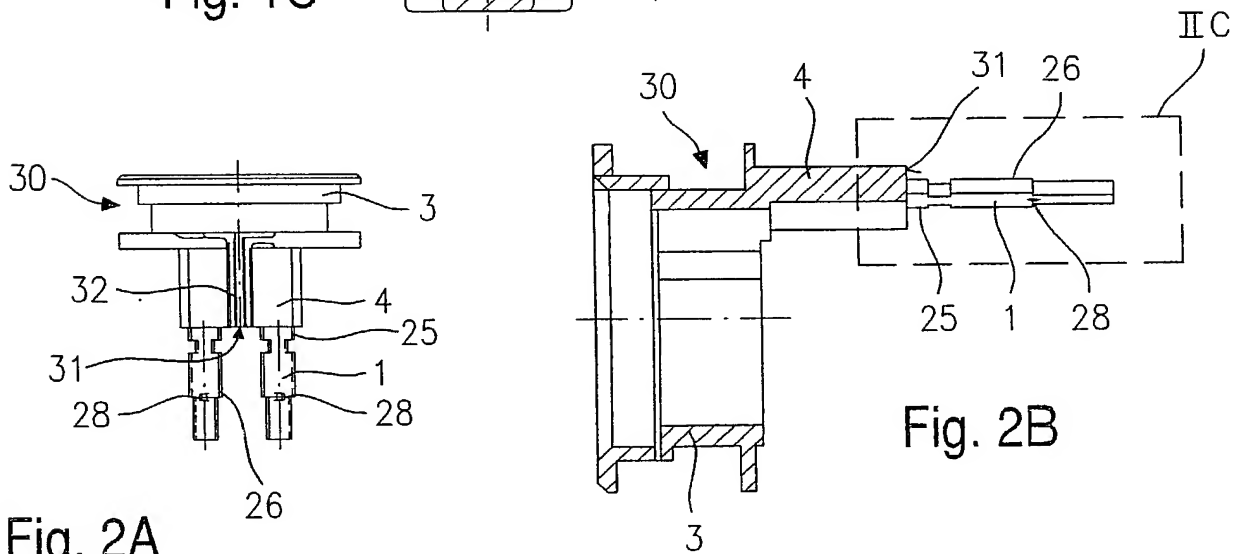


Fig. 2A

Fig. 2B

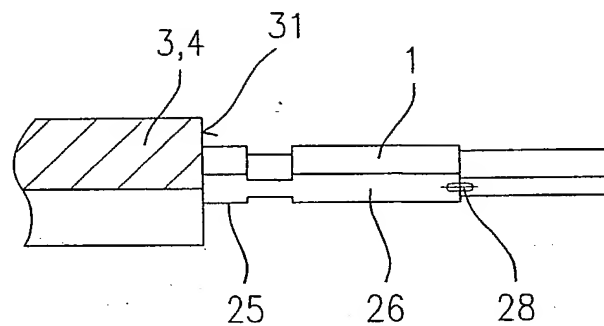


Fig. 2C

2/3

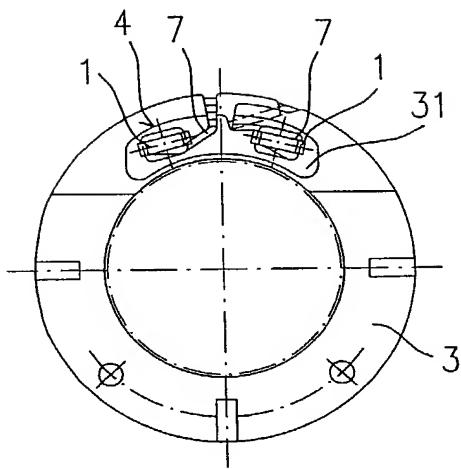


Fig. 3A

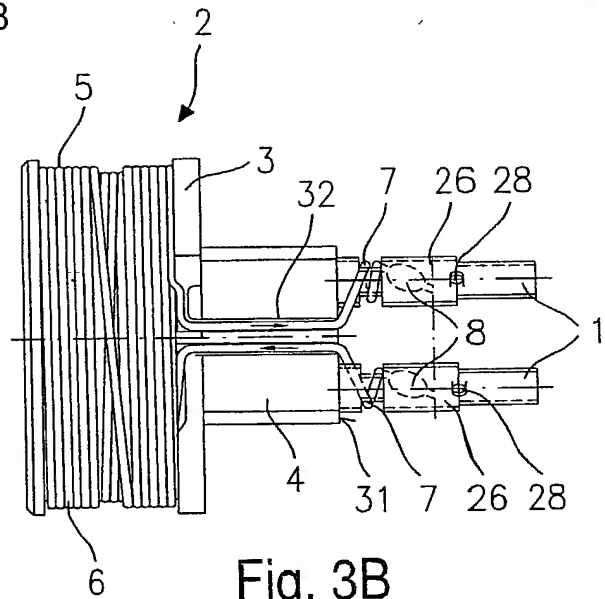


Fig. 3B

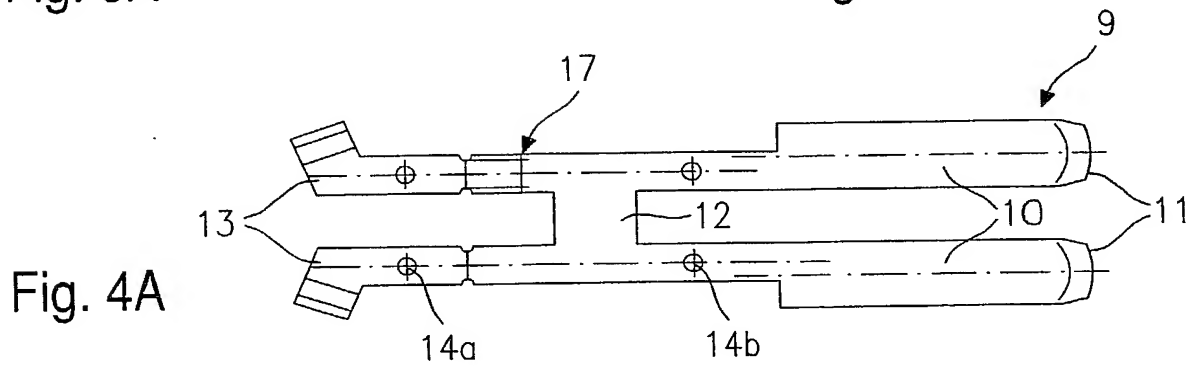


Fig. 4A

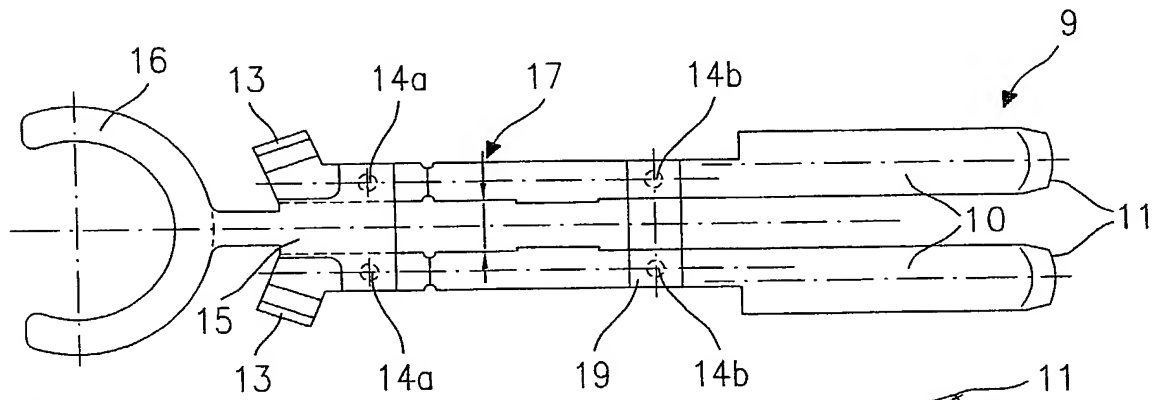


Fig. 4B

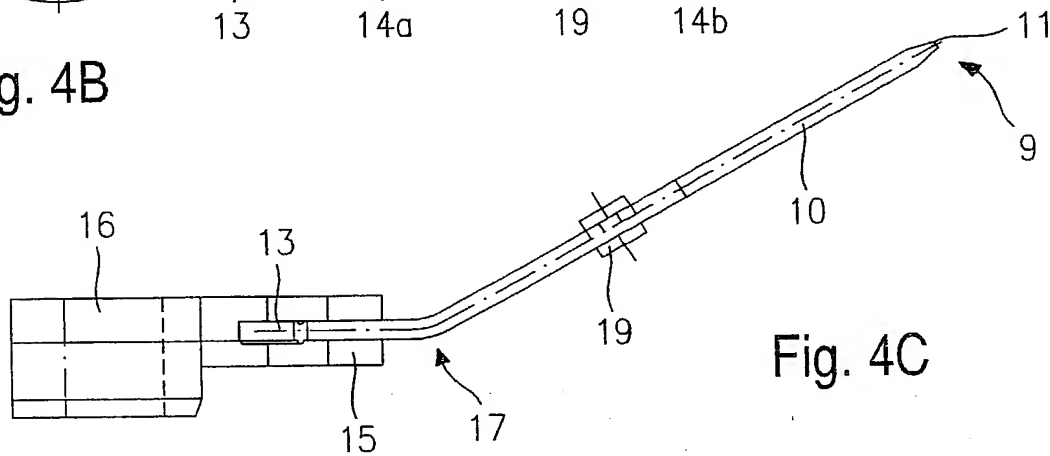


Fig. 4C

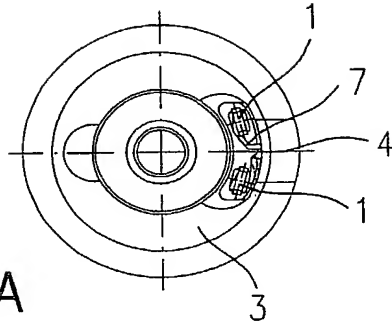


Fig. 5A

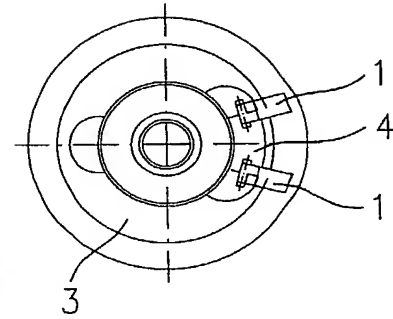


Fig. 5B

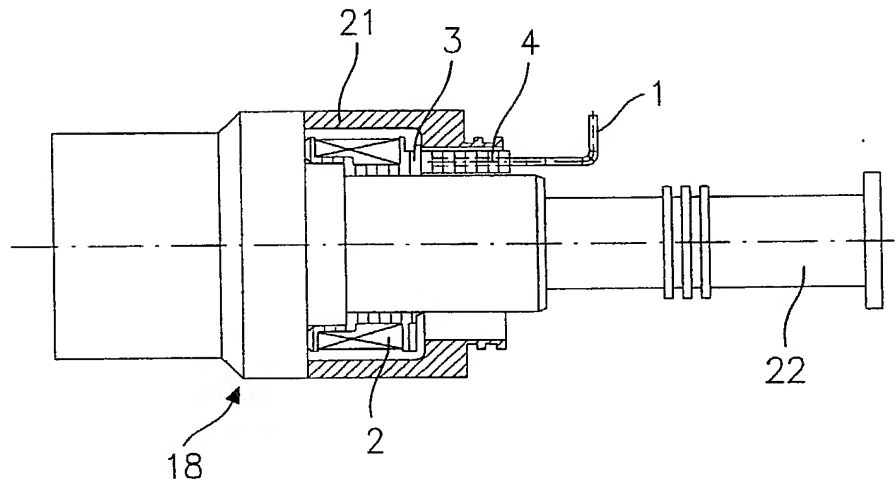


Fig. 5C

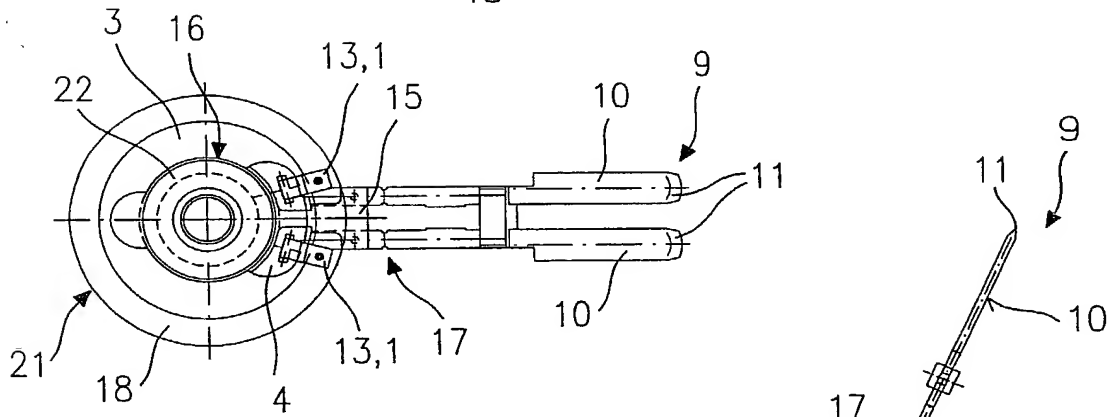


Fig. 5D

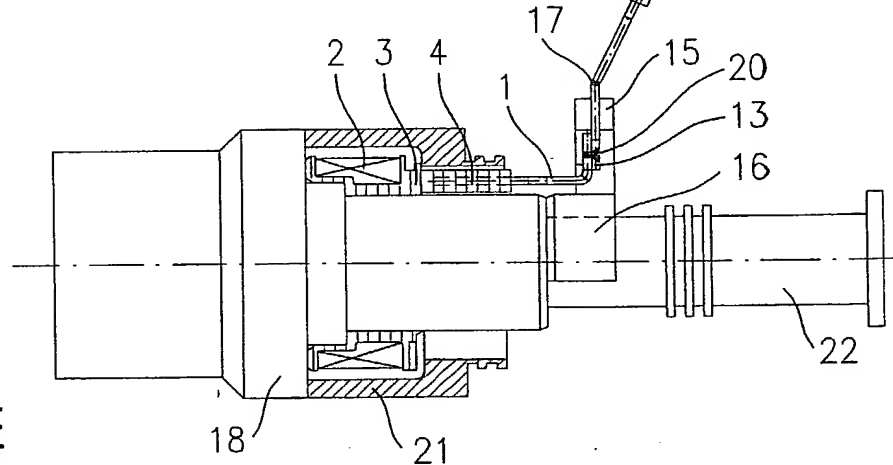


Fig. 5E

[10191/2250]

**COMBINED DECLARATION AND
POWER OF ATTORNEY FOR PATENT APPLICATION**

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below adjacent to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled **TWO-PART SOLENOID AND METHOD FOR THE MANUFACTURE THEREOF**, and the specification of which:

- ☐ is attached hereto;
- ☐ was filed as United States Application Serial No. _____ and,
- ☒ was filed as PCT International Application Number PCT/DE01/02147, on the 8th day of June, 2001

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a). I hereby claim foreign priority benefits under Title 35, United States Code § 119 of any foreign application(s) for patent or inventor's certificate or of any PCT international applications(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

Express Mail No.: EL594613935US

**PRIOR FOREIGN/PCT APPLICATION(S)
AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. § 119**

Country : Federal Republic of Germany

Application No. : 100 29 279.8

Date of Filing: 14 June 2000

Priority Claimed

Under 35 U.S.C. § 119 : ☒ Yes ☐ No

I hereby claim the benefit under Title 35, United States Code § 120 of any United States Application or PCT International Application designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations § 1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

**PRIOR U.S. APPLICATIONS OR
PCT INTERNATIONAL APPLICATIONS
DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. § 120**

U.S. APPLICATIONS

Number :

Filing Date :

**PCT APPLICATIONS
DESIGNATING THE U.S.**

PCT Number :

PCT Filing Date :

I hereby appoint the following attorney(s) and/or agents to prosecute the above-identified application and transact all business in the Patent and Trademark Office connected therewith.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

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